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LAW OFFICES OF CHARLES GUENZER
P O BOX 60729
PALO ALTO, CA 94306

EXAMINER	
OMGBA, ESSAMA	
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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte INTEGRATED MATERIALS, INC.

Appeal 2009-003600
Application 10/652,677
Technology Center 3700

Decided: October 14, 2009

Before JAMESON LEE, RICHARD TORCZON, and SALLY GARDNER LANE, *Administrative Patent Judges.*

LEE, *Administrative Patent Judge.*

DECISION ON APPEAL

A. STATEMENT OF THE CASE

This is a decision on appeal by the real party in interest, Integrated Materials, Inc. ("Integrated Materials"), under 35 U.S.C. § 134(a) from a final rejection of claims 1, 4-10, 13-15, 17-25, and 27-30[1]. We have jurisdiction under 35 U.S.C. § 6(b).

References Relied on by the Examiner

Hewitt	4,504,224	Mar. 12, 1985
Ohsawa	6,033,215	Mar. 7, 2000
Niemirowski	6,056,123	May 2, 2000
Wingo	6,171,400 B1	Jan. 9, 2001
Beyaert	6,361,313 B1	Mar. 26, 2002
Ballance	6,395,363 B1	May 28, 2002

The Rejections on Appeal

The Examiner rejected claims 1 and 8-10 under 35 U.S.C. § 103(a) as unpatentable over Niemirowski, Hewitt, and Beyaert.

The Examiner rejected claims 4, 7, and 13 under 35 U.S.C. § 103(a) as unpatentable over Niemirowski, Hewitt, Beyaert, and Ohsawa.

The Examiner rejected claim 5 under 35 U.S.C. § 103(a) as unpatentable over Niemirowski, Hewitt, Beyaert, Ohsawa, and Ballance.

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[1] The Appeal Brief mailed September 16, 2006 (hereinafter App. Br.") lists claim 16 as being on appeal. (App. Br. 2:7.) Although the Final Office Action mailed September 22, 2005 lists claim 16 as rejected on the Office Action Summary form PTOL-326, none of the Office Action, the Examiner's Answer mailed December 4, 2006, or the Supplemental Examiner's Answer mailed March 26, 2007, includes claim 16 in any statement of rejection or includes any discussion of a rejection applied to that claim. We regard claim 16 as not rejected.

The Examiner rejected claim 6 under 35 U.S.C. § 103(a) as unpatentable over Niemirowski, Hewitt, Beyaert, Ohsawa, and Wingo.

The Examiner rejected claims 14, 15, 17-20, 22, 24, 25, and 27-29 under 35 U.S.C. § 103(a) as unpatentable over Niemirowski, Hewitt, Beyaert, and Ohsawa.

The Examiner rejected claims 21 and 30 under 35 U.S.C. § 103(a) as unpatentable over Niemirowski, Hewitt, Beyaert, Ohsawa, and Wingo.

The Examiner rejected claim 23 under 35 U.S.C. § 103(a) as unpatentable over Niemirowski, Hewitt, Beyaert, Ohsawa, and Ballance.

The Invention

The invention relates to silicon support towers for supporting silicon wafers during thermal processing. (Spec. 1:10-11.)

Claim 1 is reproduced below (App. Br. 11 Claims App'x):

> A wafer support tower for supporting wafers in parallel spaced relationship along a vertical axis, comprising:
>
> two silicon bases;
>
> a plurality of silicon legs joined at opposite ends to said two bases; and
>
> a plurality of teeth having upper and lower surfaces both cut into said legs and extending outwardly from axially extending portions of said legs at an upwardly sloping angle of between 1° and 3° with respect to said vertical axis to support said wafers on upper sides of distal ends thereof.

B. ISSUES

1. Has Integrated Materials shown that the Examiner erred in determining that a person of ordinary skill in the art would have been led by

the combined teachings of Niemirowski, Hewitt, and Beyaert to recognize that a wafer support tower may have teeth with upper and lower surfaces sloped at an angle?

2. Has Integrated Materials shown that the Examiner erred in determining that taken together, Niemirowski, Hewitt, Beyaert, and Oshawa, teach a supporting surface extending horizontally in the distal end of angled wafer supporting teeth?

C. FINDINGS OF FACT

Niemirowski

1. Niemirowski discloses a tower made of silicon for supporting semiconductor wafers. (Niemirowski 2:19-31.)

2. In Niemirowski, tower 30 includes a plurality of vertical rods or legs 1 having slots 5 that receive and support semiconductor wafers 4. (*Id.* at 3:6-11.)

3. Niemirowski illustrates the slots as being formed by teeth that are horizontal and not upwardly inclined as required by Integrated Materials' claims. (Niemirowski fig.4.)

Beyaert

4. Beyaert discloses a tower for supporting semiconductor wafers during heat treatment processing. (Beyaert 1:4-12.)

5. Beyaert's Figure 4B is reproduced below:

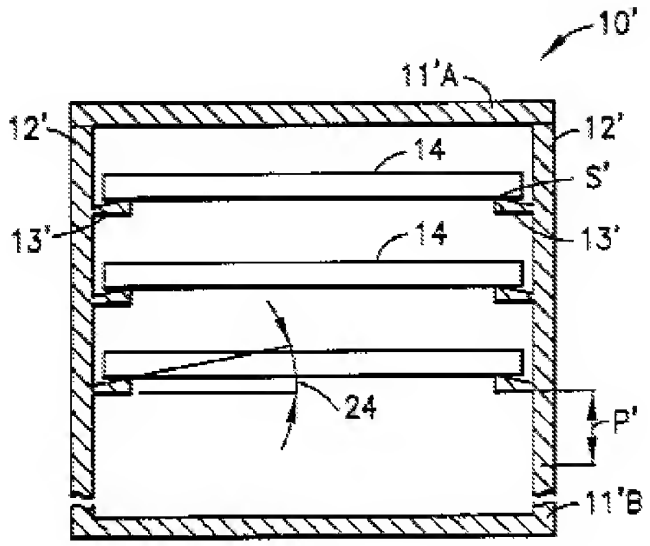

FIG.4B

The figure above depicts a tower for supporting semiconductor wafers.

6. In Beyaert, the tower includes a plurality of dividers 13' each having a ramp portion such that a wafer 14 sits on a corner of the ramp portion to minimize the contact surface S' between the ramp and wafer. (*Id.* at 6:8-12.)

7. As disclosed in Beyaert, minimizing the contact surface of the wafer and ramp portion desirably serves to "reduce the number of micro-scratches and chipping particles, and the cold zones at the active face of the water to improve deposited layer thickness uniformity." (*Id.* at 6:58-62.)

8. Beyaert also discloses that the angle that the ramp makes with the horizontal is described as either "about 3°" or "greater than zero and preferably greater than 2°." (*Id.* at 6:31-36.)

9. Beyaert further discloses that its wafer support tower may be formed with dividers or teeth having an upper angled surface formed by cutting slots in step-by-step fashion along support legs using a standard grinding machine equipped with a tilted saw blade. (Beyaert 6:12-16.)

10. Alternatively, the upper angled surface of Beyaert may be formed by first grinding "[n]ormal slots," then, using a saw blade having a special profile such as that shown in Figure 5, re-grinding the slots to form the inclined upper surface of the teeth. (*Id.* at 6:17-30; fig.5.)

11. The purpose of each of Beyaert's slot forming processes is to produce teeth with angled surfaces that receive and support silicon wafers to minimize contact between the wafers and teeth during heat treatment processing. (*Id.* at 6:8-12.)

Integrated Materials' Specification

12. Integrated Materials' invention seeks to solve the specific problems of minimizing thermal shadowing and minimizing stress and resultant crystal slip arising from the support of a disc shaped semiconductor wafer by addressing the general problem of reducing the size of the wafer supports to make smaller contact portions between the supports and the wafer. (Spec. 5:16-21; 7:23-24; 8:4-6; 13:20-24.)

Hewitt

13. Hewitt discloses a kiln that includes a ceramic ware support for holding ceramic flatware in a spaced and stacked relationship during firing of the kiln. (Hewitt 1:6-9.)

14. The ceramic ware support includes a plurality of upwardly projecting pins 24 that form a rack that supports the peripheral portions of

the ceramic ware to "minimize the area of contact" between the ceramic ware and support. (*Id.* at 2:44-56.)

Oshawa

15. Oshawa discloses a heat treatment tower for heat-treating semiconductor wafers. (Oshawa 1:13-17.)

16. Oshawa's Figure 7 is reproduced below:

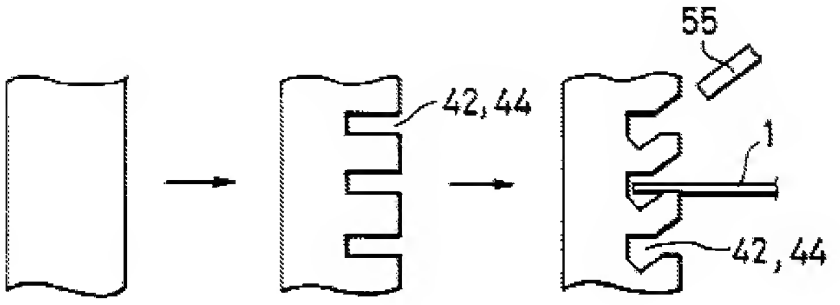

FIG. 7

The Figure above depicts a process of forming wafer supporting grooves in the legs of a support tower.

17. As shown in Figure 7, horizontal grooves 42, 44 are formed first in the support legs (unnumbered) of the tower. Then, by means of an inclined cutter 55, the groove portions are inclined upwardly forming upper and lower inclined surfaces and a horizontal or perpendicular support surface. (Oshawa 6:51-56.)

18. Wafer 1 is supported on the support surface at an inner portion of the wafer in the manner illustrated in Figure 7 resulting in less stress than a wafer that is supported at its endmost portions. (*Id.* at 6:26-31.)

19. In Oshawa, the support of its wafers distributes stress along the wafers thereby reducing the generation of slip in the wafers. (*Id.* at 2:57-61; 3:48-51; fig.11.)

D. PRINCIPLES OF LAW

A prior art reference must be considered for everything it teaches by way of technology and is not limited to the particular invention it is describing and attempting to protect. *EWP Corp. v. Reliance Universal Inc.*, 755 F.2d 898, 907 (Fed. Cir. 1985).

A reference is analogous art if it is either in the field of the applicant's endeavor or is reasonably pertinent to the particular problem with which the inventor was concerned. *In re Kahn*, 441 F.3d 977, 987 (Fed. Cir. 2006); *In re Wood*, 599 F.2d 1032, 1036 (CCPA 1979).

The problem examined is not limited to the specific problem solved by the invention but can be the general problem that confronted the inventor before the invention was made. *In re Kahn*, 441 F.3d at 988.

E. ANALYSIS

Claims 1, 10, 14, and 24 are independent claims. Claims 4-9, 13, 15, 17-23, 25, and 27-30 are ultimately dependent on one of those independent claims. Each of claims 1, 10, 14, and 24 are directed to a wafer or substrate supporting tower. The primary dispute centers on a limitation in each of those claims directed to legs of the tower having a plurality of upwardly sloping teeth for supporting the wafers or substrates.

The Examiner rejected all of the claims on appeal, at least in part, over the combined teachings of Niemirowski, Hewitt, and Beyaert. The Examiner determined that Niemirowski discloses a wafer support tower

having legs but with teeth formed in the legs that are not upwardly sloping. To remedy that deficiency, the Examiner turned to the combined teachings of Hewitt and Beyaert. In contesting the Examiner's rejections, Integrated Materials focuses its arguments on Hewitt. Integrated Materials contends that that reference is non-analogous art and thus not available as prior art in rejecting its claims. Integrated Materials further contends that it is not obvious to combine the teachings of Hewitt with either Niemirowski or Beyaert. Integrated Materials also separately argues claims 4, 7, 13, 14, 15, 17-25, and 27-30 based on an additional limitation required by those claims.

Although Integrated Materials argues that Hewitt is non-analogous art, no such argument is advanced for Beyaert. Indeed, Integrated Materials submits that all of the other references cited by the Examiner, including Beyaert, are in the same "field of semiconductor processing" as the "present invention." (App. Br. 4:23-24.) We focus first on the teachings of Beyaert.

The teachings of Beyaert

Beyaert discloses a tower for supporting semiconductor wafers during heat treatment processing. (Beyaert 1:4-12.)

Beyaert's Figure 4B is reproduced below:

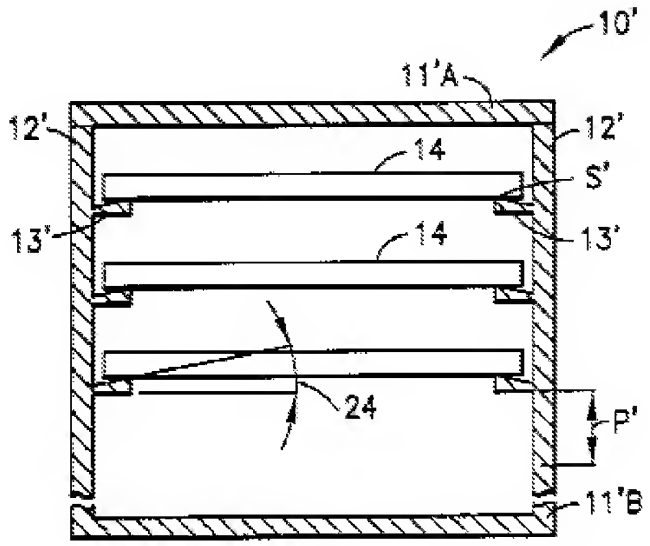

FIG.4B

The figure above depicts a tower for supporting semiconductor wafers.

In Beyaert, the tower includes a plurality of dividers 13' each having a ramp portion such that a wafer 14 sits on a corner of the ramp portion to minimize the contact surface S' between the ramp and wafer. (*Id.* at 6:8-12.) As disclosed in Beyaert, minimizing the contact surface of the wafer and ramp portion desirably serves to "reduce the number of micro-scratches and chipping particles, and the cold zones at the active face of the wafer to improve deposited layer thickness uniformity." (*Id.* at 6:58-62.) Beyaert also discloses that the angle that the ramp makes with the horizontal is described as either "about 3°" or "greater than zero and preferably greater than 2°." (*Id.* at 6:31-36.)

The Examiner determined that Beyaert's dividers 13' are teeth on the legs of a support tower that are sloped upwardly at an angle of either

"between 1° and 3°" as required by claims 1 and 10, and an angle of no "more than 3°" as required by claims 14 and 24. (Ans. 4:7-9; 7:5-7.) The Examiner reasoned that in view of the teachings of Beyaert one with ordinary skill in the art would have angled the teeth of a wafer support tower, such as in Niemirowski, to minimize the contact surface between the teeth and a supported wafer. (Ans. 4:9-13.)

Integrated Materials does not dispute or otherwise address the reasoning set forth by the Examiner. Rather, in attacking the teachings of Beyaert, Integrated Materials argues that "Beyaert's teeth are inclined only on one side," *i.e.*, the upper side or surface, and thus do not also teach an inclined or angled lower surface as required by its claims. (App. Br. 8:1-6.)

Integrated Materials' specification does not describe that the angled lower surface of its teeth has any interaction with a semiconductor wafer or provides any benefit during a heat treatment process. That is, the benefits arising from Integrated Materials' teeth are not associated with the lower surfaces of the teeth, but rather are attributed to the smaller projecting portion of the upper angled surfaces of the teeth that contact the wafer. (Spec. 5:16-18; 13:20-21.) Evidently, that the lower surfaces of its teeth are angled at all is simply a matter of expediency resulting from the cutting process that forms the upper angled surfaces of the teeth.

Beyaert discloses that its wafer support tower may be formed with dividers or teeth having an upper angled surface formed by cutting slots in step-by-step fashion along support legs using a standard grinding machine equipped with a tilted saw blade. (Beyaert 6:12-16.) Alternatively, the upper angled surface may be formed by first grinding "[n]ormal slots," then, using a saw blade having a special profile, re-grinding the slots to form the

inclined upper surface of the teeth. (*Id.* at 6:17-30.) The purpose of each process is to produce teeth with angled surfaces that receive and support silicon wafers to minimize contact between the wafers and teeth during heat treatment processing. (*Id.* at 6:8-12.)

A prior art reference must be considered for everything it teaches by way of technology and is not limited to the particular invention it is describing and attempting to protect. *EWP Corp.,* 755 F.2d at 907. Furthermore, the teachings of a reference are evaluated from the standpoint of a person of ordinary skill in the art, who is also a person of ordinary creativity, not an automaton. *KSR Int'l Co. v. Teleflex Inc.,* 550 U.S. 398, 421 (2007).

In this case, Beyaert teaches that the horizontal upper surfaces of wafer supporting teeth may be cut using a saw blade to produce an angled surface that contacts a wafer. The shape of the lower non-contacting surface of each tooth are illustrated as also being horizontal (Beyaert fig.4B) and are not described as having, or being limited to, any particular appearance. It would have been evident to a person of ordinary skill and creativity in the art that Beyaert's teaching of cutting a horizontal upper surface of a support tooth at an angle could also be implemented on the horizontal lower surface of the tooth.

Applying the teachings of Beyaert to a semiconductor support tower, such as in Niemirowski, a person of ordinary skill in the art would have recognized as obvious that the upper and lower surfaces of the wafer supporting teeth in the legs of a tower may be angled by cutting those surfaces using a tilted saw blade, as taught in Beyaert. We reject Integrated

Materials' argument that the prior art fails to teach teeth having angled upper and lower surfaces as required by the claims.

Hewitt's status as analogous art

The Examiner cited Hewitt as also teaching angled support teeth for a tower. Integrated Materials contends that Hewitt is non-analogous art and thus is not available as prior art in rejecting its claims. As set forth above, the teachings of Beyaert alone account for the requirement of sloping teeth. Thus, the additional teachings of Hewitt are unnecessary in rejecting Integrated Materials' claims.

In any event, we also reject Integrated Materials' argument that Hewitt is non-analogous art. A reference is analogous art if it is either in the field of the applicant's endeavor or is reasonably pertinent to the particular problem with which the inventor was concerned. *In re Kahn*, 441 F.3d at 987; *In re Wood*, 599 F.2d at 1036.

Integrated Materials argues that Hewitt's field of endeavor is in "the field of pottery" which is not combinable with art in the "field of semiconductor processing" of its invention. (App. Br. 4:23-24.) Integrated Materials also concludes that "the field of pottery is not pertinent to the problem the inventor is trying [sic] solve, which is fabricating long support fingers in a material (silicon) that is difficult to machine." (App. Br. 5:3-7.) More specifically, Integrated Materials characterizes the problem its inventors sought to solve as being "two fold, reduce thermal shadowing and reduce slip in the wafer." (Reply Br. 2:16-17 (filed January 31, 2007).)

We focus on the second prong of the analogous arts test, *i.e.*, whether Hewitt is reasonably pertinent to the problem with which the inventor was concerned. Here, the specific problems that Integrated Materials' invention

seeks to solve are that of minimizing thermal shadowing (Spec. 5:16-17; 7:23-24; 13:20-24) and minimizing stress and resultant crystal slip arising from the support of a disc shaped semiconductor wafer (Spec. 5:19-21; 8:4-6.) However, in ascertaining whether a prior art reference is reasonably pertinent to the problem faced by an inventor, the problem examined is not limited to the specific problem solved by the invention but can be the general problem that confronted the inventor before the invention was made. *In re Kahn*, 441 F.3d at 988.

In this case, as explained in Integrated Materials' specification, the problems of minimizing thermal shadowing and minimizing stress were addressed by confronting the general problem of reducing the size of the wafer supports of a tower to make the contact portions between the tower and the wafer smaller. In particular, the specification states each of the following:

> The legs may have a larger back portion and a smaller projecting portion for supporting the wafers, thus minimizing thermal shadowing.
> (Spec. 5:16-17.)
>
> ---
>
> The projecting portion advantageously supports the wafer at between 69% and 72% of the wafer radius to minimize stress on the wafer.
> (Spec. 5:19-21.)
>
> ---
>
> Again, the small areas of the supporting portion 34 and the surrounding structure reduce thermal shadowing.
> (Spec. 7:23-24.)
>
> ---
>
> Furthermore, thermal shadowing is reduced since, for the described towers, the wafer is supported on a [sic] narrow tooth ends . . . .
> (Spec. 13:20-21.)

All of those above-quoted portions refer to advantages arising from smaller supporting portions that reduce the contact area between a tower and a wafer. Hewitt is properly considered analogous art if it is reasonably pertinent to the general problem of reducing the contact between a supporting tower and a supported wafer.

Hewitt discloses a kiln that includes a ceramic ware support for holding ceramic flatware in a spaced and stacked relationship during firing of the kiln. (Hewitt 1:6-9.) The ceramic ware support includes a plurality of upwardly projecting pins 24 that form a rack that supports the peripheral portions of the ceramic ware to "minimize the area of contact" between the ceramic ware and support. (*Id.* at 2:44-56.) Thus, Hewitt discloses a structure for supporting flat articles of ceramic during a firing or heating process that reduces the contact between the supporting structure and the ceramic article. Simply because the structure in Hewitt supports articles made of ceramic rather than semiconductor wafers does not require that Hewitt's teachings be discarded. Hewitt's teaching of supporting a flat ceramic article during a heating process with minimal contact between the article and support is reasonably pertinent to the general problem addressed by Integrated Materials' invention in reducing contact between a wafer and support tower during a heating process. We reject Integrated Materials' argument that Hewitt is non-analogous art.

Claims 4, 7, 13-15, 17-25, and 27-30

Claims 4, 7, 13-15, 17-25, and 27-30 were rejected, at least in part over Niemirowski, Hewitt, Beyaert, and Oshawa. Each of claims 4, 13, 14, and 24 includes a limitation directed to a horizontal support surface located

at a distal end of the angled teeth. Claims 7, 15, 17-23, 25, and 27-30 are dependent, either directly or indirectly, on one of claims 4, 13, 14, and 24.

In accounting for the horizontal support surface requirement of claims 4, 13, 14, and 24, the Examiner pointed to Oshawa's Figure 7 as teaching such a support surface. (Ans. 5:1-2; 7:14.) The Examiner reasoned that (*Id.* at 5:2-6; 7:14-18):

> Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made, to have formed the teeth of the support tower of Niemirowski et al./Hewitt/Beyaert et al. with support surfaces extending perpendicularly to the vertical axis, in light of the teachings of Ohsawa, in order to securely seat the wafers.

Integrated Materials contends that (App. Br. 8:21-9:4):

> [T]he only reason Hewitt provides for the inclination of his pins is to provide a point contact support of the pottery ware being fired and supported on the tip of the triangular pins and to minimize visible pits in the glazing. Beyaert teaches the advantage of a line contact. Oppositely, Niemirowski teaches a completely flat upper surface and Oshawa teaches the advantages of a flat extended support surface but both Niemirowski and Ohsawa lack the inclined upper and lower surfaces. The Examiner needs to pick which teaching he is using and adapt the teachings as a whole instead of selectively combining only parts of disparate teachings. The inclined surfaces as they exist in Hewitt and Beyaert are designed to provide either point or line contact, not the perpendicularly extending support surfaces of the present claims.

Evidently, according to Integrated Materials, none of the applied prior art teaches teeth having inclined upper and lower surfaces with a horizontal support surfaces located at the ends of the inclined upper surfaces as claimed.

Integrated Materials' argument is not persuasive. Oshawa discloses a heat treatment tower for heat-treating semiconductor wafers. (Oshawa 1:13-17.)

Oshawa's Figure 7 is reproduced below:

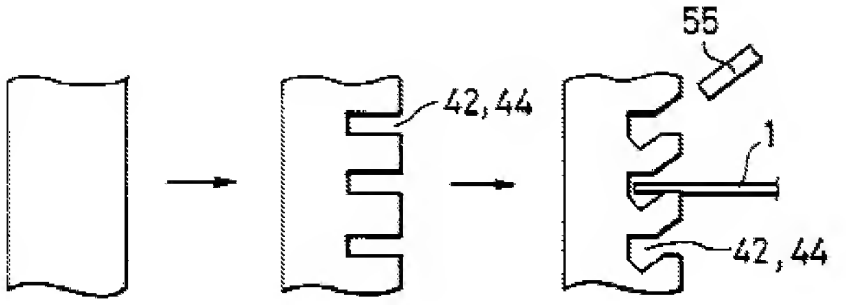

FIG.7

The Figure above depicts a process of forming wafer supporting grooves in the legs of a support tower.

As shown in Figure 7, horizontal grooves 42, 44 are formed first in the support legs (unnumbered) of the tower. Then, by means of an inclined cutter 55, the groove portions are inclined upwardly forming upper and lower inclined surfaces and a horizontal support surface. (Oshawa 6:51-56.) Wafer 1, which is supported on the support surface at an inner portion of the wafer in the manner illustrated in Figure 7, has less stress than a wafer that is supported at its endmost portions. (*Id.* at 6:26-31.) Furthermore, that configuration distributes stress along the wafer thereby reducing the generation of slip in the wafer. (*Id.* at 2:57-61; 3:48-51; Fig. 11.)

Thus, contrary to Integrated Materials' assertions, Oshawa teaches that a semiconductor support tower is desirably formed having supporting teeth with inclined upper and lower surfaces and a horizontal supporting

portion for a wafer. In light of those teachings, a person of ordinary skill in the art would have readily recognized that a semiconductor wafer supporting tower, such as that taught by the combination of Niemirowski, Hewitt, and Beyaert, would have included the wafer supporting configuration taught in Oshawa to achieve the above-noted benefits of reduced stress and slip in the supported wafers.

For all the foregoing reasons, we sustain the Examiner's rejection of each of claims 1, 4-10, 13-15, 17-25, and 27-30.

F. CONCLUSION

1. Integrated Materials has not shown that the Examiner erred in determining that a person of ordinary skill in the art would have been led by the combined teachings of Niemirowski, Hewitt, and Beyaert to recognize that a wafer support tower may have teeth with upper and lower surfaces sloped at an angle.

2. Integrated Materials has not shown that the Examiner erred in determining that taken together, Niemirowski, Hewitt, and Beyaert, and Oshawa, teach a supporting surface extending horizontally in the distal end of angled wafer supporting teeth.

G. ORDER

The rejection of claims 1 and 8-10 under 35 U.S.C. § 103(a) as unpatentable over Niemirowski, Hewitt, and Beyaert is affirmed.

The rejection of claims 4, 7, and 13 under 35 U.S.C. § 103(a) as unpatentable over Niemirowski, Hewitt, Beyaert, and Ohsawa is affirmed.

The rejection of claim 5 under 35 U.S.C. § 103(a) as unpatentable over Niemirowski, Hewitt, Beyaert, Ohsawa, and Balance is affirmed.

The rejection of claim 6 under 35 U.S.C. § 103(a) as unpatentable over Niemirowski, Hewitt, Beyaert, Ohsawa, and Wingo is affirmed.

The rejection of claims 14, 15, 17-20, 22, 24, 25, and 27-29 under 35 U.S.C. § 103(a) as unpatentable over Niemirowski, Hewitt, Beyaert, and Ohsawa is affirmed.

The rejection of claims 21 and 30 under 35 U.S.C. § 103(a) as unpatentable over Niemirowski, Hewitt, Beyaert, Ohsawa, and Wingo is affirmed.

The rejection of claim 23 under 35 U.S.C. § 103(a) as unpatentable over Niemirowski, Hewitt, Beyaert, Ohsawa, and Balance is affirmed.

AFFIRMED

KMF

LAW OFFICES OF CHARLES GUENZER
P O BOX 60729
Palo Alto, CA 94306